Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Parts 1, 2, 22, 24, 27, 90 and 95 of The Commission's Rules to Improve Wireless Coverage Through the Use of Signal Boosters	)	WT Docket 10-4 FCC 11-53
	)	

COMMENTS
NOTICE OF PROPOSED RULEMAKING

Smart Booster
Intelligent Cellular Range Extender

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Introduction

Michael Millard and Jeremy K. Raines, Ph.D., P.E., inventors of the Smart Booster, are pleased to submit the following Comments to the Notice of Proposed Rulemaking, Docket 10-4, concerning regulations for signal boosters. Since its inception, Smart Booster, as shown in Fig. 1, was designed to be portable and affordable for individual consumers so that they could, in the words of the NPRM, Paragraph 1, "improve their wireless coverage in their homes, at their jobs, and when they travel by car, recreational vehicle, or boat." At the same time, Smart Booster was carefully designed to answer the concerns of both the wireless networks and the FCC that, according to Paragraph 14 of the NPRM[1], "Poorly designed, improperly installed or malfunctioning signal boosters can cause interference to both commercial and public safety wireless networks."

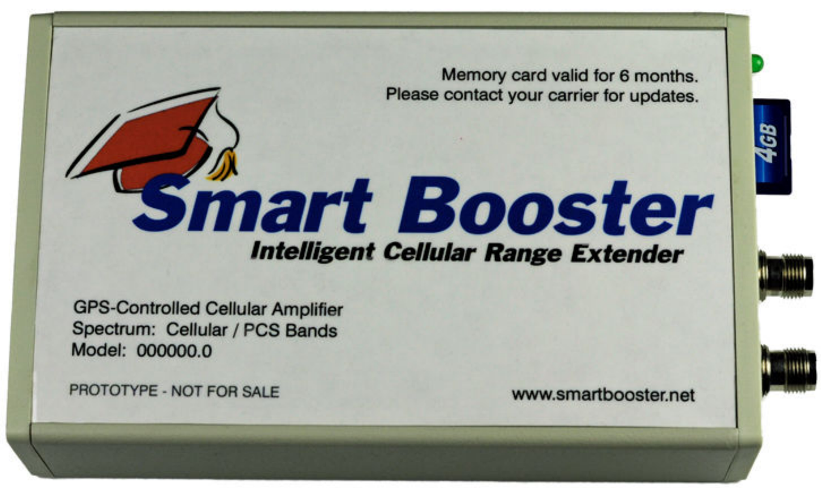

Fig. 1 – Smart Booster prototype device featuring removable, updateable memory as seen at upper right.

Accordingly, Smart Booster is the first truly intelligent signal booster. It knows where and when to amplify or not to amplify, taking into consideration not only the physics of radio wave

[1] Please see: http://fjallfoss.fcc.gov/ecfs/document/view?id=7021686520

propagation but also government rules and regulations. It also knows what part of the spectrum to amplify, which in general will vary with its geographic location.

The time for intelligent signal boosters is now. The components of such a device are well within the state of the art, and their combined costs put intelligent boosters well within the reach of the consumer. Many, if not most, modern consumer electronic devices incorporate microprocessors, memories, and other essential features of artificial intelligence. As the following discussion will show, there is no reason why signal boosters cannot exhibit similar, if not superior, intelligence in order to simultaneously satisfy the expectations of consumers, FCC regulations, and the concerns of wireless network providers.

Note that intelligent boosters are more than a paper concept. A prototype of the Smart Booster has been tested on the road in a rural area known to have unreliable coverage. It restored robust coverage in that situation. Further, it deactivated upon entering areas in which signal booster use was not needed, protecting the wireless networks from any possible interference, and completely fulfilling expectations. So, why aren't intelligent boosters in common usage?

The chief reason that intelligent boosters are not presently in the hands of consumers is that FCC rules and regulations have not encouraged them. The NPRM promises to change that regulatory environment, and Smart Booster welcomes that change; however, the degree of regulatory change required for intelligent boosters is far less than for any other kind. In particular, all that is required for intelligent boosters is modification of Rule 22.293 that presently prohibits devices between handsets and base stations. Note, however, that non-intelligent boosters would require much more in the way of new and modified regulations, which the NPRM only begins to anticipate.

In addition to a change in Rule 22.293, a good faith effort by the wireless network providers would speed intelligent signal boosters into the marketplace. The providers could assist with the creation and distribution of memory cards that are an essential component of booster intelligence. As an incentive, participation in this way by the providers would benefit them with direct control over activation of the boosters plus a new and highly profitable line of business.

In contrast, non-intelligent boosters require a huge number of regulatory changes, which the NPRM attempts to articulate; however, as these Comments will show, even those changes will fail to protect the wireless networks. There is simply no practical substitute for an intelligent booster.

Only Intelligent Signal Boosters Can Simultaneously Satisfy Consumer Demands for Improved Coverage and Carrier Demands for No Interference to Their Networks.

The NPRM cites numerous features for signal boosters that can only be provided by an intelligent device. For example, on page 15, Paragraph 37, "If it is determined that the device is operating outside of the applicable technical parameters, we propose that the device must be capable of shutting itself down automatically with ten (10) seconds (or less). We further propose that the device must remain off for at least one (1) minute before restarting. If after five (5) restarts, the device is still not operating consistent with applicable technical rules, it must shut off and remain off until manually restarted by the device operator."

The NPRM recognizes that location awareness may also be a fundamental part of an intelligent signal booster. In Paragraph 61, it asks, "…should we require boosters to incorporate location detection features as suggested by some comments?" We believe the answer is an emphatic, Yes.

The above concerns in the NPRM are clearly answered by the combination of a memory, a microprocessor, and some form of location-awareness, that is, some sort of artificial intelligence.

Further, Paragraph 39 asks, "Can specific device features minimize network impact, *e.g.,* programmability to a specific frequency block or powering on only when needed to amplify a signal?" The answer to this question is clearly, Yes, provided the signal booster is intelligent.

The carriers also state both implicitly and explicitly that they prefer an intelligent signal booster. For example, on page 21, Paragraph 56 of the NPRM, "…AT&T proposes that signal boosters may only be operated on a channelized basis on frequencies authorized for use by the wireless licensee whose signal is being boosted. AT&T suggests that manufacturers could meet this requirement by selling carrier-specific narrowband boosters or by designing 'intelligent' boosters that limit transmissions to the spectrum licensed to the carrier whose signal is being boosted."

Here, AT&T is clearly calling for an intelligent device that knows what part of the spectrum it must amplify and that knows not to amplify any other parts. There is no doubt that mobile boosters especially must possess that intelligence because spectrum allocations change as a function of location.

From the above, it is seen that the signal booster must have *a priori* knowledge of the wireless network for which it is intended, especially with respect to frequencies, channels, and spectrum blocks. The best, if not the only, way to build this knowledge into a booster is with a memory. Further, to prevent obsolescence, that memory must be updateable and must have an expiration date after which it ceases to function.

In view of the above, a signal booster must be intelligent. To satisfy the many features required and proposed in the NPRM, it must include an updateable memory, location-awareness such as provided by GPS, and a microprocessor to act upon the contents of that memory and the location. None of these components require an advance in the state of the art and none of them individually are particularly expensive. These considerations mean that intelligent signal booster will be affordable by individual consumers.

Fig. 2 shows a block diagram with the essential components of an intelligent booster.

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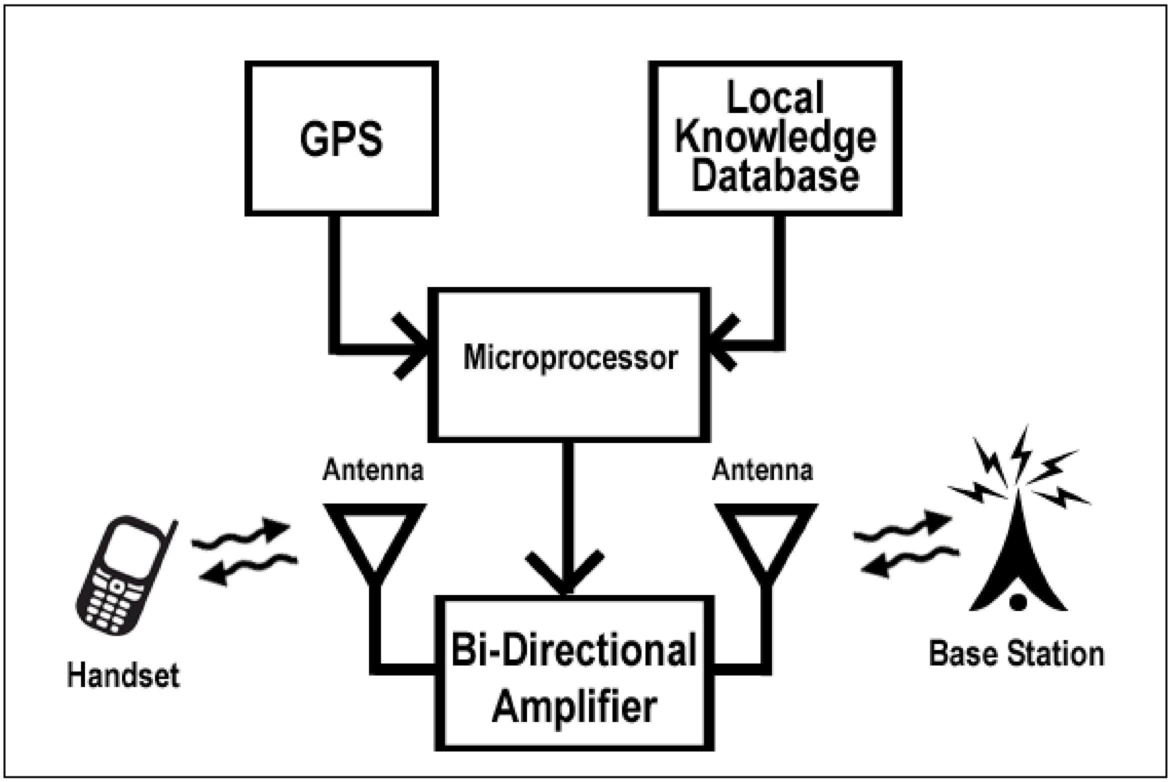

Fig. 2 - The essential components of an intelligent signal booster are individually low cost, and so the device should be well within the reach of consumers.

Objections by Carriers to Intelligent Signal Boosters Are Overcome with Data from the Public Domain.

In prior comments and communications with the FCC, carriers have objected that intelligent signal boosters would require information for their memories that would disclose proprietary data and, as a consequence of that, adversely impact carrier competitiveness and national security. We believe those objections are entirely without foundation.

In fact, the knowledge of a wireless network that would be incorporated into the memory of an intelligent signal booster is as simple as a coverage map. Such maps are readily available from the websites of most, if not all, carriers as promotional tools. Additional information to be included in the memory, for example the location and extent of Radio Quiet Zones, is also public knowledge.[2] It is seen, therefore, that neither proprietary carrier information nor national security is compromised in any conceivable way.

[2] Please see: http://www.gb.nrao.edu/nrqz/Docket%20%23%2011745%20NRQZ.pdf.

Fig. 3 shows an actual coverage map that was readily obtained from the carrier's website.

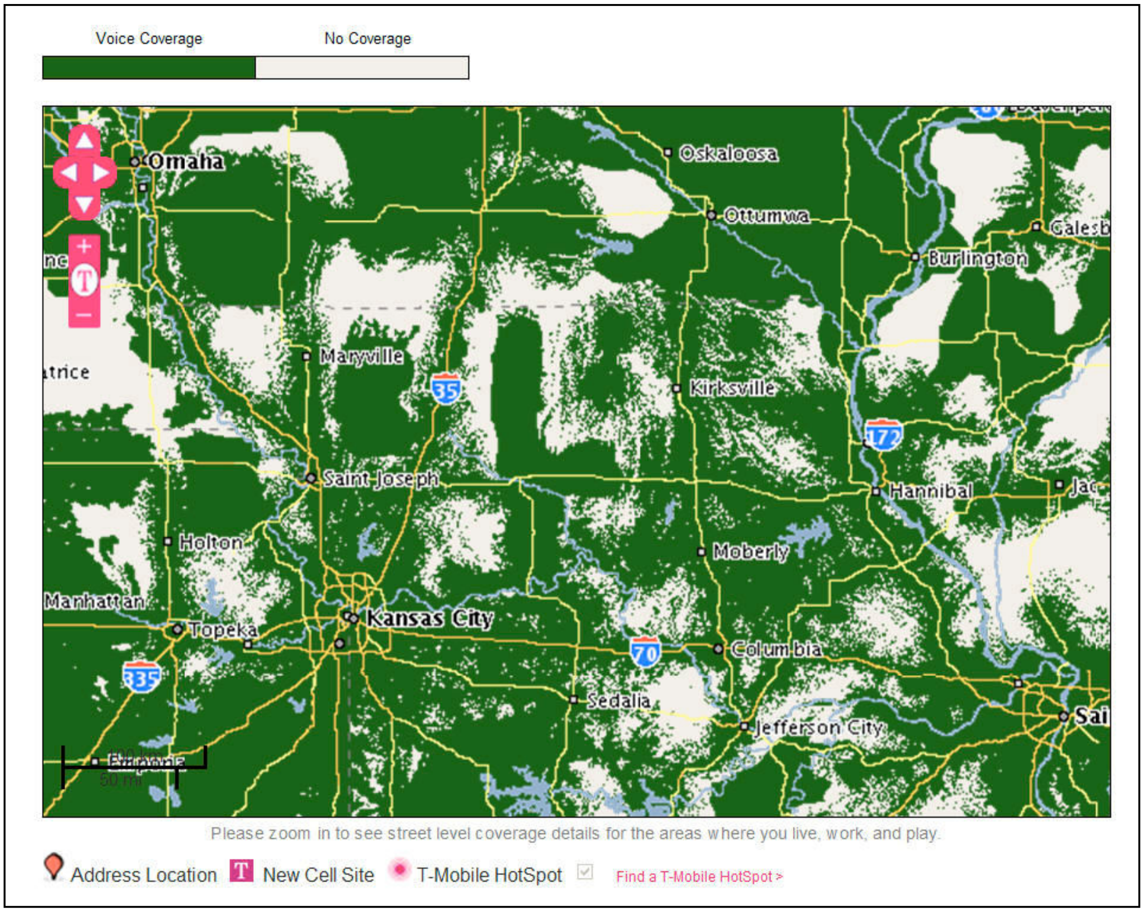

Fig. 3 - Coverage data for use in the memory of an intelligent booster is public information, and in this example from T-Mobile, readily obtainable from a carrier's website.

The carriers further protest that they do not have the staff or facilities to create or update the contents of a memory. To the contrary, carriers already perform these very functions as part of the administration of their networks, including daily operation and planning construction of future sites to accommodate subscriber growth. There is little doubt that carriers presently have network coverage information readily available with resolution often at the individual street level, far exceeding the precision required for successful booster operation. The creation, revision, and distribution of a memory card for an intelligent signal booster will be a highly profitable and self-sustaining business. That business should be very attractive to the carriers; however, if they choose not to pursue it, then a third party will.

The carriers have further objected that it is not practical for such memory contents to be timely because their networks are constantly changing. We believe that is an exaggeration based entirely on subjective reasoning. In fact, changes in networks where there are a high density of base stations and robust coverage would not effect the operation of an intelligent booster at all because it is already deactivated in those areas. It would continue to be deactivated as more base stations are added to areas already saturated with signal. That leaves changes in fringe or rural areas where the density of base stations is sparse and coverage needs boosting. In those cases, the design, planning, zoning hearings, and other preparation for changes typically require at least six to twelve months of lead time, more than enough for intelligent booster memories to be updated and distributed.

Finally, the carriers have objected that there is no way to deactivate a signal booster that has somehow malfunctioned for unspecified reasons. To the contrary, in an *Ex Parte* communication to the FCC, dated September 13, 2010, Smart Booster described in detail how authorized carrier personnel can use its “kill switch” to deactivate a booster by remote control. No doubt, the time and effort spent using the kill switch will be considerably less than that presently expended tracking down and deactivating the traditional signal boosters that interfere with today’s wireless networks.

From the above, it is seen that there are no substantive objections to an intelligent signal booster. In the opinion of Smart Booster, the objections of the carriers are no more than resistance to change.

Downlink Signal Sensing As Proposed by Some Booster Manufacturers Is No Substitute for Intelligent Signal Boosters, and, in Fact, Has Fundamental Flaws.

The NPRM anticipates signal boosters that, according to Paragraph 53, can “…power down or shut down as the device approaches the base station with which it is communicating.” This concept has been embraced and promoted by some booster manufacturers, and has been interpreted as a substitute for an intelligent signal booster. That is, a booster without any memory or *a priori* knowledge of a wireless network could somehow sense the intensity of an incoming downlink signal and adjust its amplification of the uplink signal inversely to that sensed intensity. This procedure is called “downlink signal sensing”. It is easy to explain how the procedure has serious fundamental flaws that put the wireless networks at risk.

We discuss four fundamental flaws here. They are: 1) The booster turns itself off in proximity to the wrong base station. 2) The booster turns itself on in too close proximity to the right base station and overwhelms the base station receiver. 3) The booster fails to accurately detect the intensity of the downlink signal from the base station. 4) A booster operating where it is not needed frustrates the network with respect to commands sent to the handset to adjust its uplink power. There may be other flaws as well.

The mechanism of the first flaw is straightforward. The booster does not have the intelligence to distinguish between the base stations of different wireless networks. As a result, it switches itself off whenever it senses a sufficiently strong downlink signal from any base station. If the base station happens to serve a competitor’s network, then the booster is rendered useless for its intended purpose.

The above flaw results in what may be visualized as Swiss cheese coverage. That is, the booster is switched off inside circular boundaries surrounding any base station, within which it is presumed that signals are so strong that boosting is not necessary. When those base stations belong to a competitor’s network, however, the improved coverage that should have been provided by the booster is, in fact, absent. So, the circular boundaries surrounding the competitors’ base stations are holes in coverage, suggesting a coverage map that looks like a slice of Swiss cheese.

The second flaw follows from an attempt to remedy the first one. To reduce the size of those holes in the Swiss cheese coverage, the booster is switched on in closer proximity to a base station than is required for robust communication. As a result, while the base station may not be totally disabled, its function is nonetheless compromised by signals boosted beyond the intensity anticipated by the wireless network design. In response, the base station commands all handsets within its coverage area to increase their power to match that of the boosted signal. Those handsets that cannot comply experience dropped calls. This will happen especially at the fringes of the coverage area, and so effectively that coverage area shrinks.

Fig. 4 illustrates the Swiss cheese coverage phenomenon.

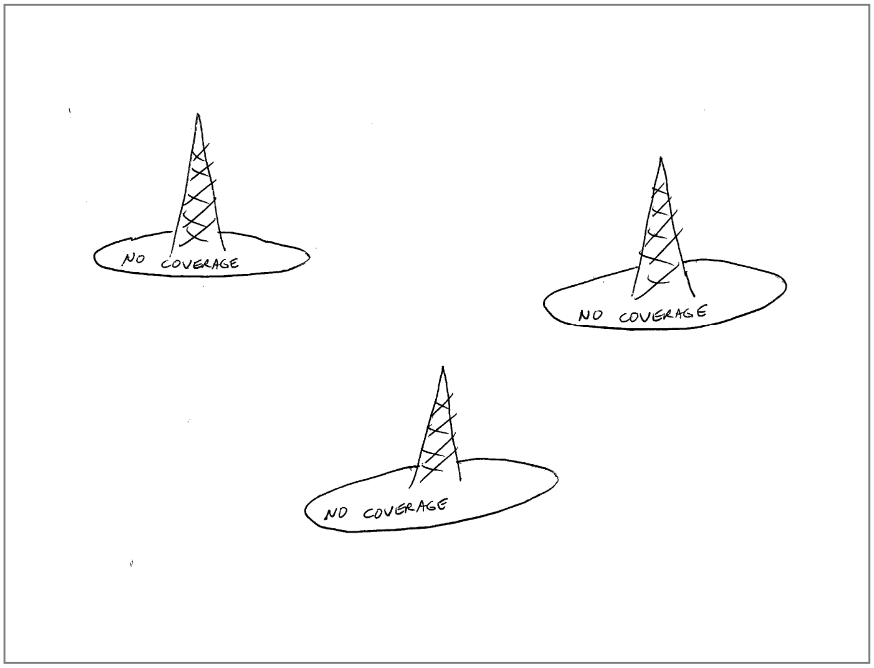

Fig. 4 - When an unintelligent booster uses downlink signal sensing in proximity to a competitor's base station, it will create holes in its own coverage area. This phenomenon is called Swiss cheese coverage.

More generally, downlink signal sensing algorithms built into non-intelligent boosters are expected to become outdated and actually harmful. Such algorithms make assumptions about the base station receiver they are intended to protect. Advances in wireless communications technology, however, inevitably collide with such assumptions to the extent that they are either no longer valid or must be significantly revised. Indeed, even in this proceeding, those assumptions are under re-examination. What will happen as wireless networks continue to evolve? Will the downlink signal sensing assumptions for today's boosters be compatible with the networks of tomorrow or will they become an impediment?

The third flaw follows from reliance upon each and every individual signal booster to measure the intensity of base station downlink signals with precision and accuracy. Most likely, as with many consumer devices, such reliance is unjustified. For example, a broken or improperly installed donor antenna will adversely affect the required precision and accuracy. For a single device this malfunction might be tolerable; however, the statistics for a widely deployed consumer device guarantee that there will be multiple malfunctions, and these will certainly put the networks at risk.

Even if the intensities of the base station downlink signals are accurately detected and measured, the fact remains that modern wireless networks are designed to work best when each handset transmits the *minimum* amount of power necessary for successful communication. It follows that unnecessary boosting of this minimum power is simply another form of interference. A booster is therefore improperly installed if it is activated at a location where signal boosting is not necessary.

The fourth flaw follows from an inherent conflict between a handset and a booster at locations where the latter is not needed but is nonetheless activated, which will often be the case with downlink sensing. Modern wireless networks maintain continuous control of the handset's uplink power. In contrast, the network does not communicate with the booster, and the booster has no ability to decode or respond to the commands from the network concerning its level of amplification. The result is a material loss of dynamic range for the uplink power of the handset. For example, if the handset uplink power without a booster has a dynamic range of 70 dB, then a 40 dB signal booster that will not deactivate reduces that dynamic range to only 30 dB. That means the combination may not be able to reduce power sufficiently to satisfy the network and will frustrate its commands. Thus, the network is compromised with respect to controlling handset uplink power for optimal capacity.

An intelligent signal booster avoids all of the above flaws. Intelligent boosters know where they are from GPS or similar location sensing. They do not depend upon sensing proximity to base stations and somehow determining the identity of the wireless network associated with each and every base station. Their memories tell them where and when boosting is required, and on what part of the spectrum. Note that the wireless networks have the opportunity to directly influence the memory contents as their engineering departments specify when and where booster operation is permissible.

Even If Downlink Signal Sensing Could Be Made to Work, There Is No Justification for It in Densely Populated Areas.

In view of the foregoing arguments, downlink sensing is a fundamentally flawed concept because it means that signal boosters are activated where they simply are not needed. Proponents might argue that, in areas of robust coverage, the amplification of a booster can be made variable so that it mimics the dynamic range of a handset alone. In that case, however, why have a booster at all? More importantly, why have thousands or millions of such boosters activated where they are not needed at all? With these large numbers, clearly an unnecessary risk factor introduced into the network.

Smart Booster Opposes License-by-Rule Because It Is Risky, and Because It Is Completely Unnecessary for Intelligent Signal Boosters.

Smart Booster opposes a License-by-Rule approach to signal boosters for at least the following reasons: because it is risky for present and future wireless networks and because it is unnecessary for intelligent signal boosters. In particular:

A) License-by-rule strips carriers of their spectrum stewardship, which has long proven itself to be the most effective incentive for minimizing external interference and maximizing efficient utilization of spectrum.
B) License-by-rule is unnecessary for intelligent signal boosters that can operate *solely* on the spectrum already licensed to a particular carrier.
C) Signal boosters are not standalone transmitters or transceivers, and therefore do not require new and complicated transceiver rules. It would make more sense to regulate signal boosters using existing rules governing the transceivers with which the boosters are intended to operate. This is the same approach the Commission already takes with booster and translator stations in Parts 73 and 74 of its broadcast rules.
D) License-by-rule will confuse consumers, who are generally not accustomed to adjusting and maintaining wireless appliances that must comply with a license.
E) License-by-rule will make future network changes difficult, if not impossible, because there will be no mechanism for recalling older yet operational boosters that impede those changes.
F) License-by-rule assumes that signal boosters will not interfere, but, in fact, unnecessary signal amplification is itself a form of interference because networks are designed to operate with the *minimum* power necessary for successful communications. Instead, what is needed is an intelligent signal booster that can automatically limit its operation solely to those carriers, locations, spectrum, and situations for which signal boosting is actually required.

Intelligent signal boosters render license-by-rule unnecessary because they are selective with respect to frequency band, block, and channel, and because their operation is based upon the fusion of knowledge concerning both the physics of radio wave propagation and government regulations.

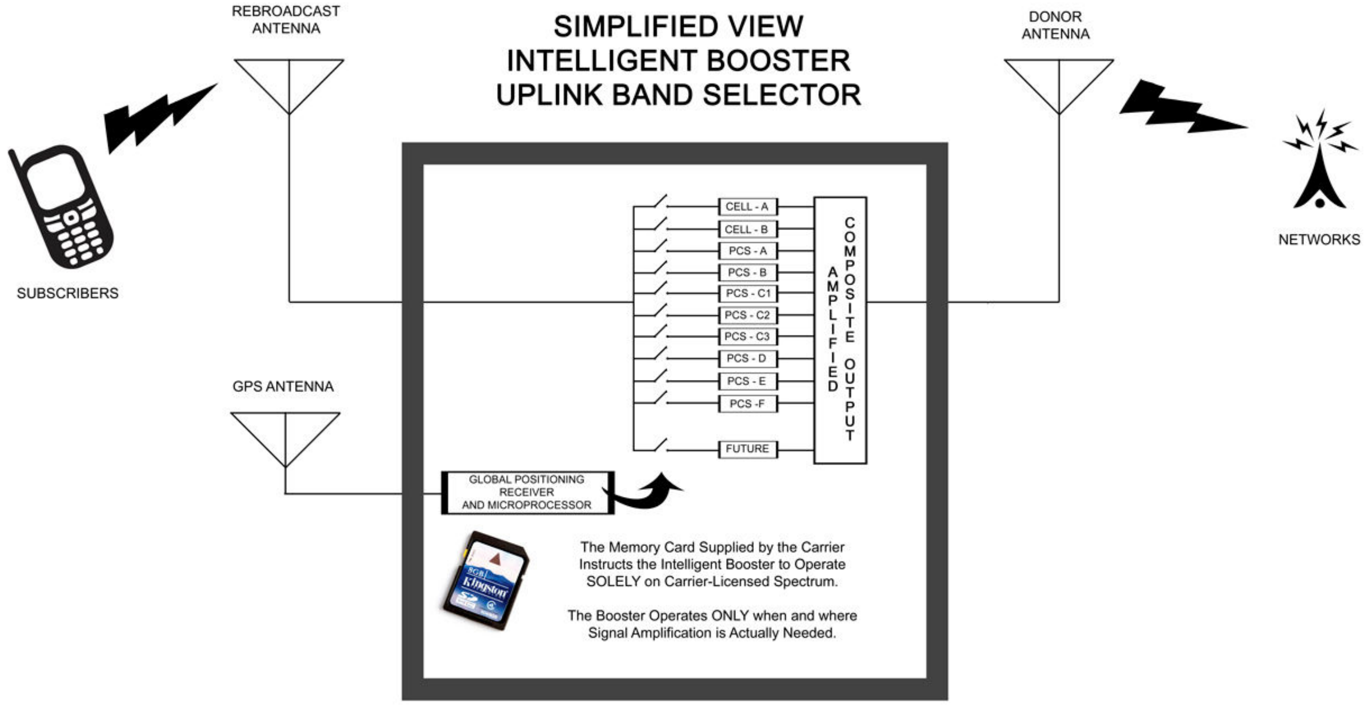

Fig. 5 - Simplified diagram of an Intelligent Booster uplink band selector

With respect to being frequency selective, Figure 5 shows a simplified diagram of an intelligent booster's uplink signal path. It is seen that each band and channel block is individually enabled or disabled prior to amplification, based upon the actual need for signal boosting at that location. The bands and channel blocks selected, if any, will match those licensed to a particular network provider and will in general change, according to need, as the booster changes location within the network.

For example, a network provider may have a license in one area to offer wireless telecommunication services on cellular channel block "B", and PCS blocks "D" and "F". In such a case, the intelligent booster will enable amplification for these three blocks, and disable the rest. If a carrier decides that signal amplification is not required at a given location, those bands and channel blocks will not be amplified.

As the booster moves to different coverage areas of the network, where the providers' licensed channel block assignments are different, the intelligent booster will automatically reselect the appropriate part of the spectrum .

Because intelligent signal boosters can precisely mimic a carrier's FCC license, there is no need to experiment with a License-by-Rule regulatory framework that attempts to pigeonhole or otherwise accommodate non-intelligent traditional signal boosters.

Automatic band and channel block selection is an important, fundamental difference between an intelligent signal booster and all other signal boosters considered thus far in these proceedings. Because FCC licenses are issued on both geographic and frequency bases, it stands to reason that a signal booster should be capable of respecting these same criteria.

The ability of an intelligent signal booster to operate strictly within the parameters of existing FCC carrier licensing, and only at locations and in situations that actually require signal boosting, results in some very positive outcomes. Because an intelligent booster includes both location awareness and a memory that fuses knowledge of the physics of radio wave propagation with knowledge of government regulations, it can function optimally in at least the following situations:

1) *in geographic areas governed by negotiated interference agreements;*
2) *in proximity to specified radio-telescope facilities;*
3) *in proximity to federally established "Radio Quiet Zones";*
4) *in geographic areas governed by carrier spectrum leasing agreements;*
5) *in proximity to police, fire and public safety radio facilities;*
6) *in systems requiring the minimum signal for successful communication; and*
7) *aboard private aircraft.*

Traditional boosters, including those relying upon downlink signal sensing, are not capable of functioning properly in the above situations for reasons discussed below.

1) Only an intelligent signal booster can comply with negotiated interference agreements governing overlapping coverage areas.

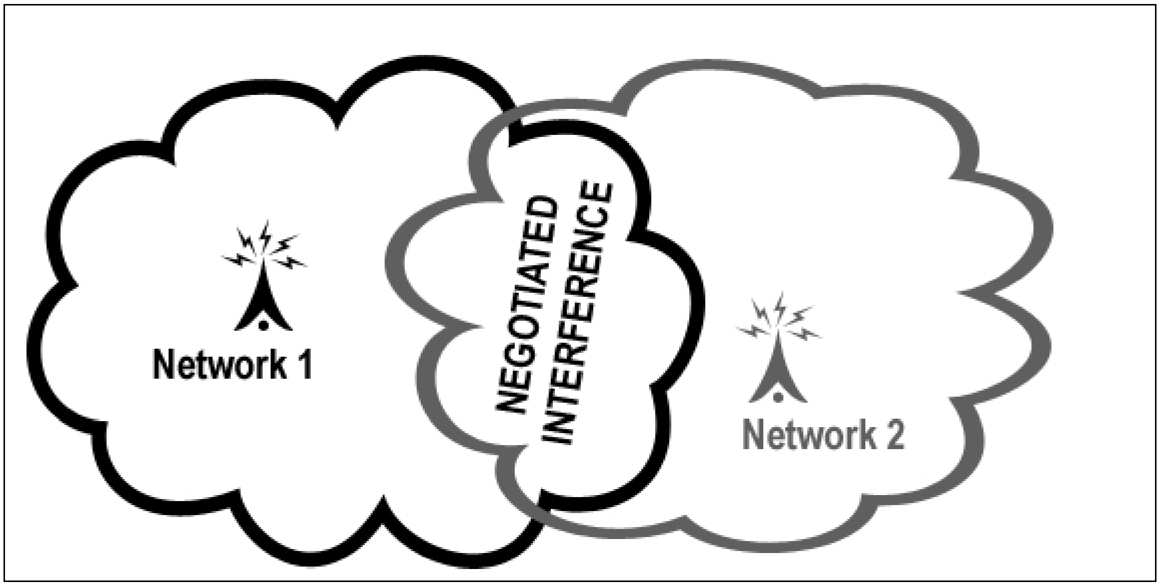

Fig. 6 - Overlapping coverage areas may be subject to negotiated interference agreements. Only an intelligent signal booster can recognize the existence of such agreements and adjust its operation accordingly.

Wireless telecommunications providers are permitted by FCC rules to negotiate the limit and extent of interference that may occur in their respective coverage area overlaps with adjacent providers. For example, please see 47CFR22.911(d)(2)(i) for more information.

Only an intelligent signal booster is capable of recognizing these negotiated interference agreements amongst the various carriers. Other boosters can not accurately determine whether their operational status should be “on” or “off” in negotiated interference coverage regions, as depicted in Figure 6 above. This is particularly true in the case of signal boosters that use downlink signal sensing, a technique in which the booster’s output power is determined in response to the signal strength received from the base station.

The capability of an intelligent booster to determine and set its output power in conformance with negotiated interference agreements between two or more wireless telecommunications enhances compliance with FCC rules and provides carriers with greater flexibility when deploying boosters on their respective networks. Furthermore, the ability of an intelligent booster to respect intra-carrier negotiated interference maximizes spectrum utilization in those networks, and thereby serves the public interest, necessity and convenience.

2) Only an intelligent signal booster can avoid causing interference in or near federally protected areas such as those surrounding radio-telescope installations, where excessive signal from signal boosters could harm operation of the telescope.

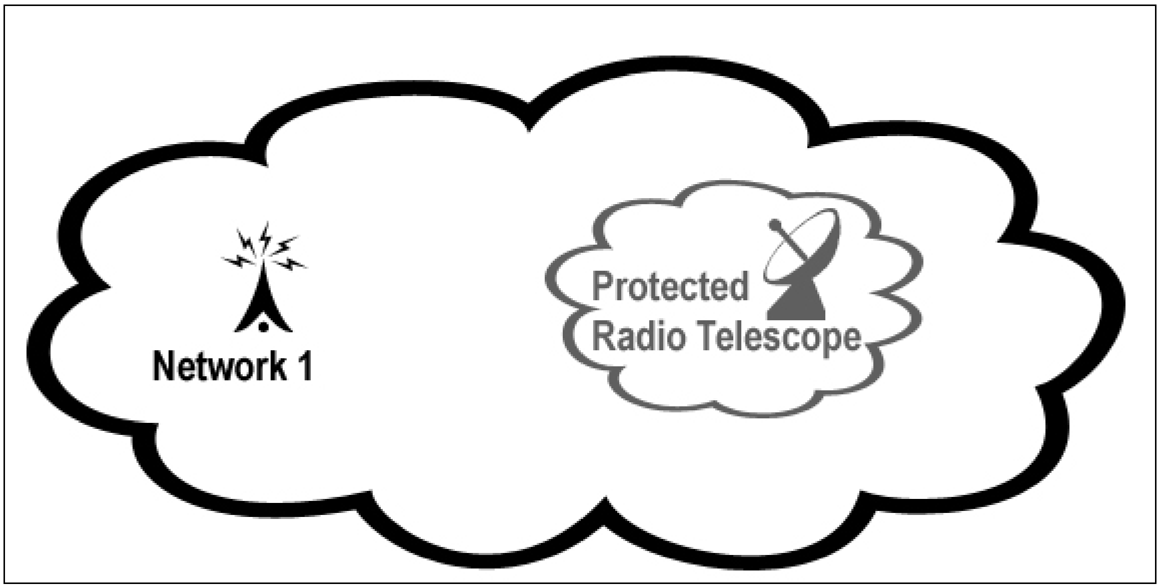

Fig. 7 - Within a network, governmental regulations protect radio telescopes facilities from excessively strong radio frequency transmissions. Only an intelligent booster can adequately protect radio telescopes located at specific geographic coordinates within a network.

Certain radio-telescope facilities are protected against high levels of radio frequency energy, such as those broadcast by a signal booster, repeater, transmitter or handset. This protection requirement, depicted in Figure 7 above, is codified in Federal and/or State law, including international treaties to which the United States is a signatory, and/or local land use regulations.

For example, the National Radio Quiet Zone (NRQZ) was established by the Federal Communications Commission in Docket No. 11745 (November 19, 1958) and by the Interdepartment Radio Advisory Committee (IRAC) in Document 3867/2 (March 26, 1958) to minimize possible harmful interference to the National Radio Astronomy

Observatory (NRAO) in Green Bank, WV and the radio receiving facilities for the United States Navy in Sugar Grove, WV.[3]

The NRQZ is bounded by the 1983 North American Datum (NAD-83) meridians of longitude at 78d 29m 59.0s W and 80d 29m 59.2s W and latitudes of 37d 30m 0.4s N and 39d 15m 0.4s N, and encloses a land area of approximately 13,000 square miles near the state border between Virginia and West Virginia. Improperly controlled operation of unintelligent signal boosters, within these geographic boundaries could violate applicable law.

Only an intelligent booster is capable of anticipating the legal requirement to protect radio-telescopes from harmful interference in the form of excessively amplified signals. Existing boosters can not accurately determine whether their operational status should be "on" or "off" in proximity to these radio-telescopes. Again, this is particularly true in the case of signal boosters that use downlink signal sensing, a technique in which the repeater's output power is determined solely in response to the signal strength received from the base station.

The capability of an intelligent signal booster to set its output power in response to known geographic coordinates of radio-telescopes whose radio frequency environments are protected by regulation enhances compliance with FCC rules and provides carriers with greater flexibility when deploying boosters on their respective networks.

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[3] Please see: http://www.gb.nrao.edu/nrqz/Docket%20%23%2011745%20NRQZ.pdf for additional information.

3). Only an intelligent signal booster can avoid causing interference in or near federally protected "Radio Quiet Zones", geographic areas within which, federal law restricts the signal strength of radio frequency devices, including transmitters, repeaters, signal boosters and handsets to certain minimum values.

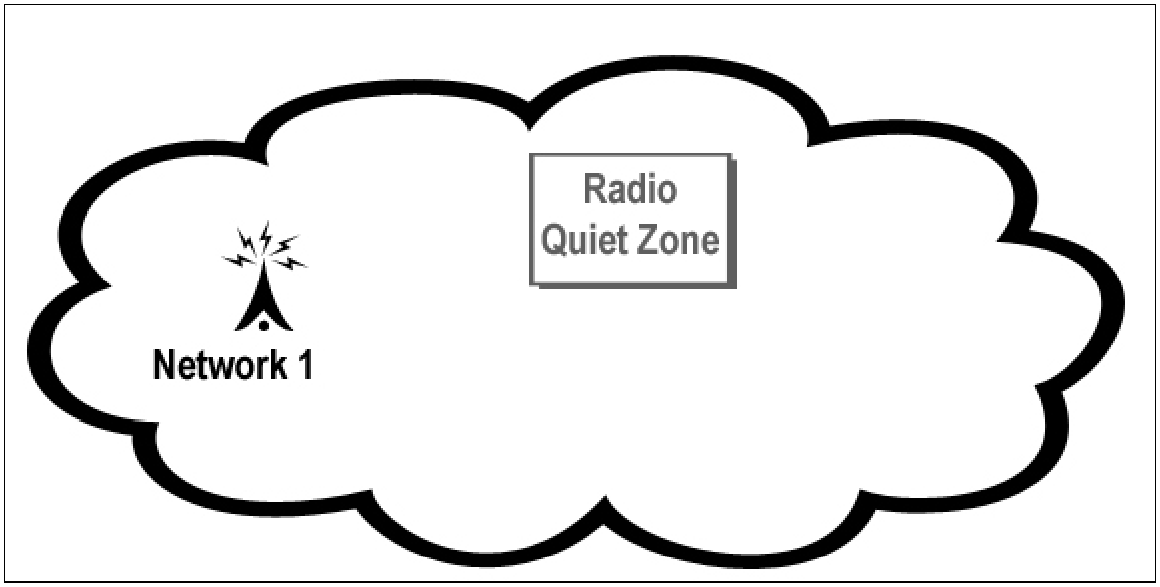

Fig. 8 - Federal regulations establish certain geographic boundaries, within which, strong radio signals are strictly prohibited. Only an intelligent signal booster can recognize the need to protect such geographic areas contained within a network.

Similar to the above situation involving radio-telescopes, there exist many geographic areas unrelated to radio astronomy whose radio frequency environments are also protected by law. One such example, depicted in Figure 8 above, is the US Department of Commerce's Table Mountain Field Site (TMFS), near Boulder, Colorado.

The Table Mountain Field Site, jointly operated by the US Department of Commerce and the Institute for Telecommunications Sciences, is designated by the FCC as a "Radio Quiet Zone" and is protected by Federal and State regulation from strong external radio signals. This restriction ensures that the Department of Commerce laboratories and research affiliates can study the characteristics and propagation of electromagnetic radiation in a real-world environment with minimal interference from uncontrolled sources of external radio interference.

Only an intelligent booster is capable of complying with the legal requirement to protect facilities such as the Table Mountain Field Site from excessively amplified signals. Unintelligent boosters can not accurately determine whether their operational status should be “on” or “off” in proximity to these facilities. This is particularly true in the case of signal boosters that use downlink signal sensing, a technique in which the repeater’s output power is determined solely in response to the signal strength received from the base station.

The capability of an intelligent signal booster to set its output power in response to known geographic coordinates of “radio quiet zones” whose radio frequency environments are regulated by law enhances compliance with FCC rules and provides carriers with greater flexibility when deploying boosters on their respective networks.

4) Only an intelligent booster can recognize leased portions of a network, and respond accordingly.

Fig. 9 - Telecommunications providers are permitted to lease portions of their network to third parties. Leases may be administered on a geographic or frequency basis.

As illustrated in Figure 9 above, telecommunications providers are permitted to lease all or a portion of their network to third parties pursuant to FCC rules.[4] Because a single

[4] In October 2003, the Commission released the first Report and Order and Further Notice of Proposed Rulemaking [WT Docket 00-230 & FCC 03-113], in which it established new policies and procedures to facilitate broader access to valuable spectrum resources through the use of spectrum leasing arrangements. The Report and Order adopted rules permitting licensees in

network is thus capable of being operated by more than one company, it is no longer viable assume that any requirement for signal boosters will apply uniformly to the entire network.

Only an intelligent signal booster is capable of recognizing leased portions of a network, which may have different requirements, or no requirement, for signal amplification. What is needed is an intelligent booster that is sufficiently “smart” and foolproof to know when and where to amplify, or not to amplify, especially in leased spectrum environments.

Furthermore, the capability of an intelligent booster to set its output power in order to protect those portions of the network that have been leased to third parties enhances compliance with FCC rules and provides carriers with greater flexibility when deploying boosters on their respective networks.

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the Wireless Radio Services holding exclusive use licenses to lease some or all of the spectrum usage rights associated with their licenses to third parties.
Please see: http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-03-113A1.pdf

5) Only an intelligent booster can deactivate when necessary to protect critical public safety radio installations, regardless of the spectrum those installations might use.

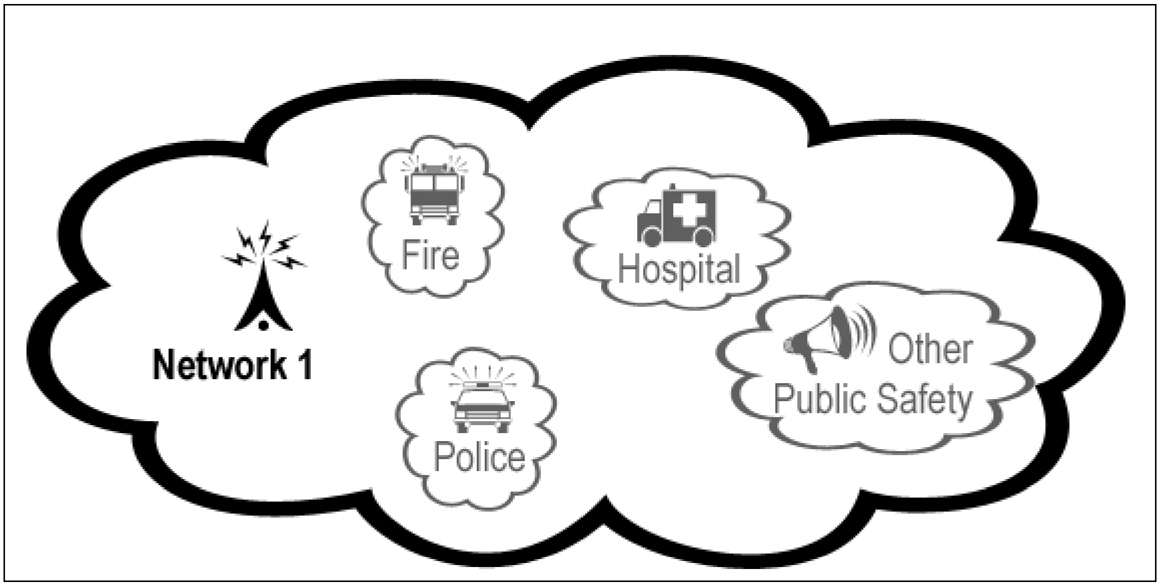

Fig. 10 - Various public safety radio installations also benefit from the elimination of excessively strong signals. Only an intelligent booster is capable of recognizing the geographic locations of these facilities, and of adjusting its operation accordingly.

While not necessarily protected by federal regulation, except according to certain criteria[5], there exist numerous police, fire and other public safety radio communications facilities that would likewise benefit from protection against excessively amplified signals, as shown in Figure 10.

Unintelligent boosters are not capable of protecting these public safety radio facilities because they have no knowledge that they exist within any particular coverage area. As a result, existing signal boosters can not accurately determine whether their operational status should be "on" or "off" in proximity to police, fire and other critical public safety radio communications facilities. This is particularly true of signal boosters that use

[5] For example, FCC rule 47CFR22.970 governs unacceptable interference to Part-90 non-cellular 800 MHz licensees (i.e., two-way radio) from cellular radiotelephone or Part-90 800 MHz cellular systems. Furthermore, FCC Rule 47CFR22.971 obligates cellular providers to resolve such interference should it occur. Note importantly however, that many police, fire and other public safety communications systems do not operate in the 800 MHz spectrum, and thus, are not afforded the protection these two FCC rules provide, even though such protections are highly desirable. An intelligent signal booster would provide these protections.

downlink signal sensing, a technique in which the booster's output power is determined solely in response to the signal strength received from the base station.

The capability of an intelligent signal booster to set its output power in response to known geographic coordinates of police, fire and other public safety wireless communications installations enhances compliance with FCC rules and provides carriers with greater flexibility when deploying boosters on their respective networks.

Furthermore, the capability of an intelligent signal booster to set its output power in order to protect the geographic coordinates of police, fire and other public safety wireless communications towers is an unappreciated advantage over unintelligent boosters because it solves a particularly difficult interference problem that can seldom be remedied with filters or other hardware-based interference abatement techniques.

6) Only an intelligent booster can enforce the use of the minimum power necessary for successful communications in all circumstances.

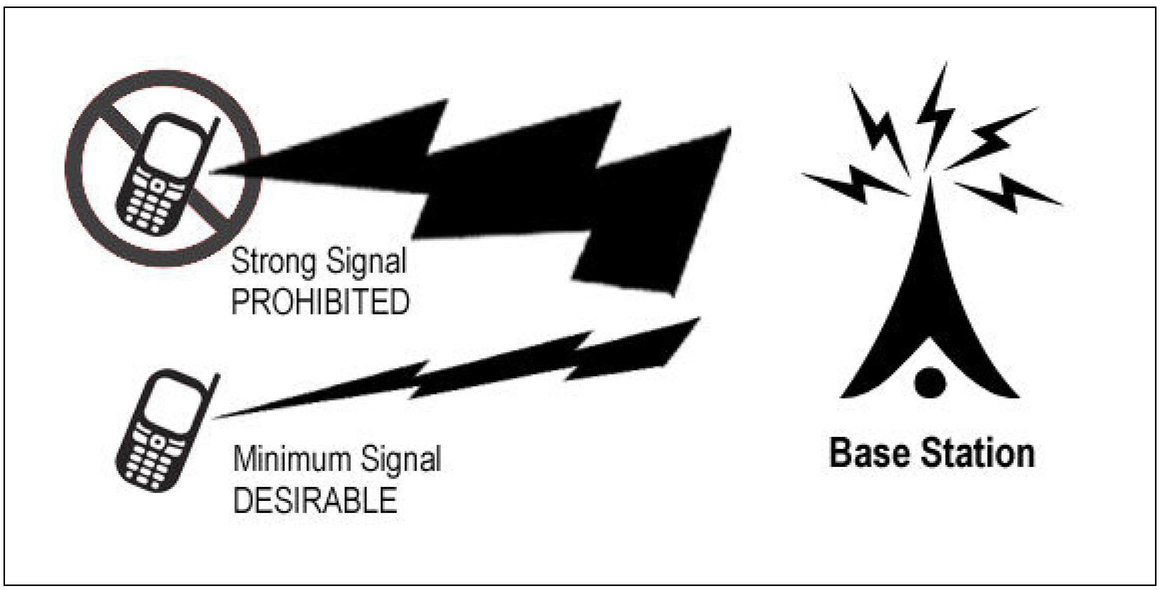

Fig. 11 - Government regulation prohibits excessively strong signals in certain frequency bands, including PCS. Only an intelligent signal booster is able to adjust its operation so that it complies with these regulations at every geographic point within the network.

Modern wireless networks use sophisticated signaling schemes that rely upon mobile handsets emitting the minimum amount of uplink power for successful communications.

In support of this reliance, networks command mobile handsets to increase or reduce their output powers according to the strength of all signals received at the networks' base stations. In some signaling schemes, these up/down power commands may occur at a rate of 1,500 times per second.

A cellular device, for example a handset, smart phone, etc., has an intrinsic minimum and maximum output power. This range of output powers is controlled by the wireless network, primarily in response to the path loss between the handset and a base station.

However, two special situations arise whenever a cellular device is paired with a booster and is physically located close to a base station.

In the first of these, the minimum output power of the cell phone, amplified by the booster, produces a signal that is far greater in magnitude than the network requires for successful communications, as shown in Figure 11. This is a form of harmful interference because the network will have no choice but to instruct all other devices on the network to "power up" to meet this uncontrolled uplink power from the booster. This results in a shrinkage of the network's intended coverage areas because handsets already at the fringe of coverage may be operating at maximum power and cannot comply with the request for increased power. Hence, these calls are dropped.

Additionally, such boosted signals, when not required for successful communications, directly violate FCC Rule 47CFR24.232(c), which states:

> *"Mobile/portable stations are limited to 2 watts EIRP [Effective Isotropic Radiated Power] peak power and the equipment must employ means to limit the power to the minimum necessary for successful communications."*

In the second situation, a cellular device, paired with a booster, is located close to a base station, but not the base station that is providing coverage, for example a base station belonging to another network. This is known as the "near-far" problem. The booster is physically near a competing network, but is far from its serving network. In this case, the amplified combination of a cell phone plus a signal booster may generate signals that overwhelm the competing network's base station because it desensitizes that base station's receivers.

What is needed in both cases described above is an intelligent signal booster that is smart enough to know when and where these situations occur within a network coverage area and to adjust its output power accordingly. Note importantly that downlink signal sensing techniques, as championed by Wilson Electronics, are wholly incapable of solving these problems. Furthermore, any downlink signal sensing approach capable of recognizing the "near-far" problem will necessarily result in "Swiss cheese coverage". That is, the booster registers a false positive because it is in close proximity to a competing network's base station strong downlink signal, and as a result disables amplification when it should actually be providing it.

Only an intelligent signal booster is capable of solving both of the above described situations, primarily, because they have knowledge that such situations exist, and operate solely on a carrier's licensed spectrum. Unintelligent signal boosters can not accurately determine whether their operational status should be "on" or "off" in response to these situations.

The capability of an intelligent signal booster to set its output power to comply with the optimal network design that uses the minimum amount of power necessary for successful communication supports FCC rules and regulations relating to that design. It also provides carriers with greater flexibility when deploying boosters in their networks.

7) Only an intelligent booster can disable itself if attempts are made to operate it at high altitude.

Signal booster use at high altitudes may be undesirable. As with handsets, signal boosters operating at high altitudes can interfere with wireless communications networks. This interference occurs because modern wireless networks rely upon thousands of base stations each serving a small geographic area. However, a signal booster operating at altitude illuminates a very large geographic area, thus interfering with the coverage areas of individual base stations.

In recognition of this problem, the FCC disallows the use of cellular transceivers aboard all aircraft, but the FAA allows their use aboard private aircraft[6]. In short, there exists a regulatory loophole that only an intelligent booster can close absent further legislative action.

8) Only an intelligent booster can solve the Sprint / Nextel spectrum interleave problem with public safety allocations.

Because the re-banding effort is not yet complete in many markets, Sprint Nextel SMR (Specialized Mobile Radio) licenses are still interleaved with narrowband public safety spectrum allocations. As a result, broadband signal boosters can not be deployed in these areas without unintentionally amplifying portions of the public safety band.

An intelligent booster solves this complex issue. In the case that a market is still interleaved, the memory of the intelligent booster may be instructed to deactivate the booster, or alternatively, allow activation only at those locations where both SMR and public safety licensees consent to such operation. This action protects both the SMR and Part-90 public safety spectrum allocations from interference. Once the market has been re-banded, a subsequent update to the intelligent booster's memory card can enable operation in the market.

[6] FCC Rule 22.925 prohibits the use of cellular transceivers while an aircraft is airborne. However, it is unclear that 47CFR24 poses a similar restriction to the operation of PCS transceivers. 14CFR91.21 bans the use of certain portable electronic devices aboard commercial aircraft but this prohibition does not extend to private aircraft. FAA Advisory Circular AC-91.21-1B recommends that aircraft operators blanket ban all intentional radiators, but compliance with the Advisory Circular is optional.

License-by-Rule Is Unnecessary for Intelligent Boosters Because, Among Other Reasons, They Are Enabled Just Like Handsets.

In addition to the many reasons discussed in the foregoing section, intelligent boosters are enabled by a memory card just like cell phones and other handsets are enabled. An essential component of an intelligent signal booster is a completely removable and updateable memory card, which fuses timely information about the wireless network, the physics of radio wave propagation, and government regulations. The memory card further includes an expiration date beyond which the signal booster cannot continue to operate.

Analogously, an essential component of a handset is its SIM (Subscriber Identification Module) card. Without it, the handset cannot operate.

Subscribers should have no difficulty accepting the renewable memory cards of intelligent signal boosters. Those same subscribers are already accustomed to physically handling removable memory cards in wireless handsets, digital cameras and other consumer electronics products. With regard to wireless handsets, the industry has long relied upon a removable memory in the form of a SIM card.

SIM cards are already available from an impressive diversity of retailers, including the carriers themselves via direct sales. Many SIM cards are issued under a private label and cater to the specific needs of niche segments of the broader subscriber base. For example, National Geographic offers a SIM Card tailored to the unique international calling patterns of outdoorsmen and explorers.[7] In essence, a SIM card has become as commonplace as a pre-paid calling card for traditional landline telephones.

There can be no doubt that the average wireless subscriber is already accustomed to using removable, updateable memories.
They presently remove memory chips from their handsets in order to upload files or photographs to their home or business personal computers. The handling of removable

[7] http://shop.nationalgeographic.com/ngs/browse/productDetail.jsp?productId=1074681&code=SR50001

and replaceable memory chips is also commonplace in digital photography, e-book readers, voice recorders, printers, MP3 players, video cameras, electronic image picture frames and a slew of other consumer electronics.

Most important to the wireless network providers, the memory cards in both the intelligent signal booster and the handset effectively place those devices under the control of the providers, especially if they are in charge of distributing the cards. In that way, a network provider controls what boosters and handsets can operate as part of its license. There is no need for an additional license-by-rule.

The Proposed Rule Creates an Artificial and Unnecessary Distinction Between Fixed Signal Boosters and Mobile Ones.

Smart Booster is convinced that Table 1 in the NPRM is unnecessary and counterproductive. An intelligent booster can be either fixed or mobile with no change in its configuration. There is no need, with respect to engineering design, to articulate separate requirements for fixed and mobile devices. In contrast, Table 1 has two separate columns, one labeled Fixed Signal Boosters and one labeled Mobile Signal Boosters. Critical examination of the two columns shows that their differences are artificial and unnecessary.

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TABLE 1			
Requirements		**Fixed Signal Boosters**	**Mobile Signal Boosters**
Comply with technical parameters (*e.g.*, power and unwanted emission limits) for the applicable spectrum band, and RF exposure requirements for the type of device (*i.e.*, fixed or mobile)	*Manufacturers*	●	●
Automatically self-monitor operations and shut down if not in compliance with our technical rules	*Manufacturers*	●	●
Power down, or shut down, automatically when a device is not needed, such as when the device approaches the base station with which it is communicating	*Manufacturers*		●
Market and label consumer signal boosters in a way that provides consumers with clear information specifying the legal use of the devices	*Manufacturers*	●	●
Upon notification, immediately cease operation in the event the device causes harmful interference to wireless network operations	*Operators*	●	●
Coordinate frequency selection and power levels with the applicable wireless carrier(s) prior to operation	*Operators*	●	

Table 1 - Reprinted from page-4, NPRM FCC 11-53, Docket 10-4.

First, let us examine the column for Fixed Signal Boosters. According to that column, the one attribute that fixed boosters must have that is not required of mobile boosters is: "Coordinate frequency selection and power levels with the applicable wireless carrier(s) prior to operation". Based upon previous discussions in this Comment, that requirement is automatically satisfied by the memory card of the intelligent signal booster. It contains knowledge of the frequency bands, channels, and blocks for operation at a particular location. It also contains knowledge of the level of amplification needed at that location. Further, that knowledge is automatically coordinated with the applicable wireless carriers because those carriers prepared and distributed the memory card, or delegated its preparation and distribution. There is absolutely no need to marry this requirement exclusively to fixed signal boosters.

As further evidence of the artificial distinctions between fixed and mobile boosters, note that even if the signal booster does not move, the network surely does. For example, carriers continue to build new cell sites and these sites are likely to encroach on previously coordinated fixed signal booster positions. Carriers often erect temporary sites called COW's (Cell site On Wheels) to service large sporting events and similar occasions. Carriers also merge and acquire each other, buy, trade or lease spectrum, and engage in similar activities to the extent that coordination as proposed in the NPRM is practically impossible. It is seen that the relative positioning of the network and so-called fixed signal boosters is, in fact, not fixed at all. This is increasingly true as the number of boosters increases.

Second, let us examine the column for Mobile Signal Boosters. According to that column, the one attribute that mobile boosters must have that is not required of fixed boosters is: "Power down, or shut down, automatically when a device is not needed, such as when the device approaches the base station with which it is communicating." Clearly, an intelligent signal booster has this capability. Fundamental to its operation is the knowledge, contained within its memory, of where it must power down or shut down completely.

In view of the above, it is seen that there is no need to distinguish between fixed and mobile signal boosters, provided they are intelligent signal boosters.

E-911 Features Are Less Important Than the Ability to Simply Connect an Emergency Call.

In Paragraph 19, the NPRM speculates that signal boosters will compromise the Location Measurement Units (LMU's) of E-911 systems. The LMU's determine the precise location of the caller but do not take into account the effects on its computations by signal boosting. This speculation, however, only strengthens the case for intelligent boosters. The only reason E-911 is discussed in the NPRM is that the present generation of boosters is not constrained to operation in unserved and underserved areas. Instead, they are deployed everywhere, and they can affect the LMU's accuracy in those urban and suburban areas equipped with E-911 systems.

In the more desirable case, in which intelligent boosters operate *only* where their use is required for successful communication, it should be acceptable to simply complete the call, even though possibly misleading the LMU of the E-911 system. If the choice is between successful communication with less LMU accuracy, and no communication at all, then the choice is obvious.

Perhaps even more importantly, in the very places where intelligent boosters will operate, many Public Safety Answering Points (PSAP's) have no capability for E-911 Phase-II location determination. Furthermore, the FCC already permits wireless carriers to exclude counties or portions of counties from providing LMU's where those carriers determine that providing them is technologically limited or impossible. Typically either heavy forestation or the inability to triangulate a caller's location are the reasons for the exclusion.[8]

How Much Will an Intelligent Booster Cost?

An intelligent booster can be expected to cost approximately the same as many traditional boosters presently on the market, in the neighborhood of $400 retail. However, the true cost of any signal booster must consider the harm that it can cause to the networks. For example, if a signal booster interferes with the network, carrier revenue is lost, and subscriber enjoyment and productivity may suffer. Additionally, the carrier can be expected to spend considerable sums tracking down and squelching interfering signal boosters.

Furthermore, because intelligent boosters do not interfere with the networks, and because they are channelized to operate only with particular carriers, those carriers may choose to subsidize the cost to consumers, much as they already do for microcells, femtocells and smartphones.

[8] http://www.fcc.gov/guides/wireless-911-services

A National Signal Booster Clearinghouse for Fixed Boosters Only Is Useless, and Completely Unnecessary for Intelligent Boosters.

In Paragraph 64 of the NPRM, the Commission proposes a National Signal Booster Clearinghouse which would somehow coordinate fixed signal boosters with the local wireless providers. No such clearinghouse is necessary for intelligent boosters. We believe the clearinghouse approach to preventing interference offers no advantage for at least the following reasons:

Most obviously and arguably most importantly, the proposed clearinghouse does not and cannot include mobile boosters. It serves no purpose to regulate fixed boosters if mobile boosters will be operating at practically the same location, as illustrated in Fig. 12.

From the carrier's point of view, the interference is the same, whether the source is the fixed booster registered with the clearinghouse, or an unregistered mobile booster in the parking lot. For certain, much precious time and resources will be consumed tracking down the wrong device when the interference does not originate with any type of booster. The interferor could be some entirely different type of electronic device.

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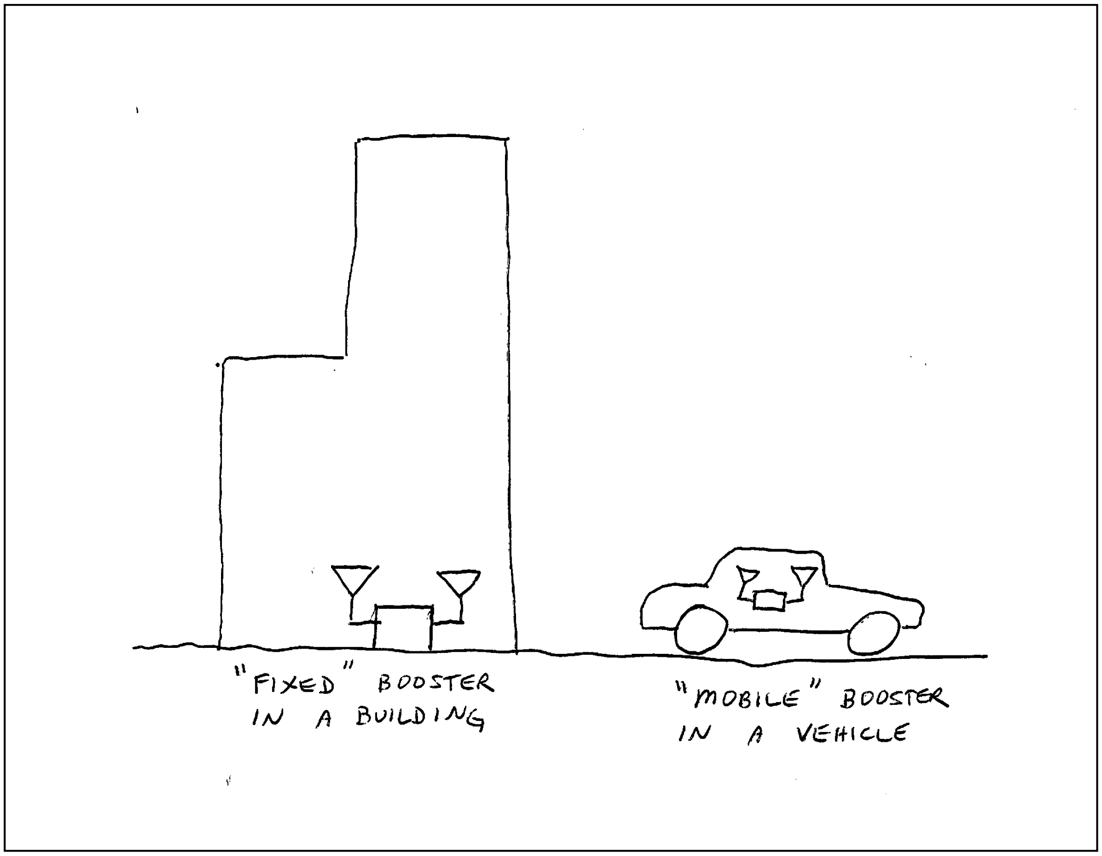

Fig. 12 - Creating a National Signal Booster Clearinghouse for only fixed signal boosters makes no sense because mobile boosters will be operating at practically the same locations.

The National Signal Booster Clearinghouse concept is fraught with many additional perils, including the following:

First, history has shown that many databases, including several administered by the FCC, accumulate errors and omissions over time. This is particularly true where an entity's mandatory participation in the database is not well understood by that entity.

Second, the National Signal Booster Clearinghouse will not be sufficiently comprehensive to solve the problems for which it is created. For example, signal boosters will continue to operate in areas that are not readily accessible to the carriers. Restricted access maritime ports, airports, military bases and even gated residential communities will cause significant delays in locating and identifying a particular interferor.

Simply querying a National Signal Booster Clearinghouse for installed boosters at a military base, for example, may return dozens of matches; however, there is no guarantee that any of those matches is the actual source of interference. The booster owner may have failed to register the device, or something other than a booster, registered or not, is the actual interferor. In any case, the total duration of the interference event can be expected to be lengthy, directly negating the presumed benefit a National Signal Booster Clearinghouse might provide.

Note that mandatory registration of all fixed boosters with a National Signal Booster Clearinghouse raises the same concerns that carriers have expressed regarding an intelligent booster's memory card. That is, in the aggregate, the clearinghouse would disclose information relating to frequency use and coverage which the carriers consider proprietary. For sure, at a National Signal Booster Clearinghouse that information would somehow become available to competitors. In that regard, the carriers would retain far more privacy by creating and distributing memory cards for intelligent boosters.

From the above, it is seen that a National Signal Booster Clearinghouse attempts to accomplish what an intelligent signal booster readily and thoroughly achieves; however, the clearinghouse attempt falls far short of expectations.

Conclusions

Intelligent signal boosters are clearly the answer for both consumers and the wireless network providers. They will satisfy consumer demands for reliable signal coverage where it is presently marginal or unusable. They will satisfy carriers' demand for devices that will not interfere with present or future versions of their wireless networks. No other booster can simultaneously satisfy both sets of demands.

With intelligent signal boosters, there is no need for License-by-Rule. The memory card of the intelligent signal is analogous to the SIM (Subscriber Information Module) card in a cell phone or handset. Without it, neither device will operate. Since the network provider controls the contents and distribution of the card, or delegates those responsibilities, it controls what devices operate under the umbrella of its existing license. There is no need for a sweeping change to the rules relating to that license.

With intelligent signal boosters, there is no need for Table 1 or to delineate in any way between fixed signal boosters and mobile signal boosters. Similarly, there is no need for a National Signal Booster Clearinghouse. By virtue of their memory cards, intelligent signal boosters coordinate frequency bands, channels, and blocks with the wireless carriers prior to activation. Also by virtue of the knowledge contained in their memory cards, intelligent signal boosters know when and where to power down or shut down completely.

Intelligent signal boosters provide performance that far exceeds the expectations of the Proposed Rule Making. Not only do they respond to the physics of radio wave propagation, but they also respond to government regulations concerning radio quiet zones, radio telescopes, overlapping coverage areas, and many other special situations. No other booster can respond in that way.

Anything less than an intelligent signal booster will inevitably cause problems with the wireless networks, and especially with future versions of those networks. In particular, Smart Booster cautions against downlink sensing as either a temporary or permanent fix to interference problems. It has been explained in detail how this technique is fundamentally flawed.

In our comments dated February 4, 2010, in response to Docket 10-4, we recommended the following regulatory changes. They still seem appropriate today and are worth repeating here.

1. Amend Rule 22.923 to permit boosters to be inserted between handsets and base stations, and update certain of its definitions.

2. Require all boosters to have a minimum amount of intelligence so that they know where to amplify, when to amplify, how much to amplify, and within which spectrum blocks to amplify.

3. Require that all intelligent boosters have a provision to guarantee that their intelligence is current.

4. Decertify all boosters that do not meet the above minimum requirements.

5. Require networks to support intelligent boosters by providing databases appropriately encoded on a compatible memory card in a timely manner.

The above conceptually simple steps will hasten the debut and wide acceptance of intelligent boosters into the marketplace. In contrast, non-intelligent boosters would require an imponderable number of regulatory changes, which the NPRM only begins to anticipate.

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VIA: ECFS.

CERTIFICATE OF SERVICE

I, Jeremy K. Raines, Ph.D., P.E., do hereby certify that on this 22nd day of July, 2011, I caused copies of the foregoing "Comments – Notice of Proposed Rule Making" FCC 11-53, Docket 10-4, to be delivered to the following via electronic or First Class US mail.

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FCC 2.803 Compliance Notice:

Prototype - Not for Sale
The Smart Booster device has not been authorized as required by the rules of the Federal Communications Commission. This device is not, and may not be, offered for sale or lease, or sold or leased, until authorization is obtained.

Intellectual Property Notice: